REMARKS

Claims 1-7 are pending, of which claims 1-7 are amended for clarity. Reconsideration and allowance of the present application based on the following remarks is respectfully requested.

Claims 1-7 were rejected under 35. U.S.C §102(e) over Omi et al., JP 2000-040695. Applicants respectfully traverse this rejection because the effective filing date under §102 of the Omi et al. reference is after Applicant's priority date of November 25, 1999. Therefore, Omi et al. is not valid prior art. To perfect Applicants' claim for priority, Applicants submit that an English translation of the certified priority documents was filed on October 4, 2001.

Claims 1-5 and 7 were rejected under U.S.C §103(a) over Asamaki et al., U.S. Patent No. 4,950,956, in view of Okumura et al., U.S. Patent No. 6,297,165. This rejection is traversed because there is no motivation or suggestion in Asamaki et al. or Okumura et al. to combine Asamaki et al. and Okumura et al. as suggested in the Office Action.

Independent claim 1 recites a plasma processing apparatus comprising, among other elements, an auxiliary electrode provided on an outer periphery of a first electrode to excite plasma in a vicinity of the auxiliary electrode and a magnetic field generator configured to apply a magnetic field to a surface of the substrate to which the plasma process is applied, wherein electrons in the plasma drift from a front surface of the auxiliary electrode to a back surface thereof and from the back surface of the auxiliary electrode to the front surface thereof. Similarly, independent claim 7 recites a plasma processing method comprising, among other elements, applying a magnetic field to a surface of the substrate to which the plasma process is applied, exciting plasma on at least a back surface of an auxiliary electrode provided on an outer periphery of a first electrode and causing electrons in the plasma to drift from a front surface of the auxiliary electrode to the back surface thereof and from the back surface of the auxiliary electrode to the front surface thereof.

Although the Office Action recognizes that Asamaki et al. fails to teach or suggest a plasma processing apparatus having an auxiliary electrode, as recited in independent claim 1, and fails to teach or suggest exciting plasma on at least a back surface of an auxiliary electrode, as recited in claim 7, the Office Action asserts that Okumura et al. remedies this deficiency by teaching an auxiliary electrode provided on an outer periphery of a first electrode to excite plasma. The Office Action further speculates that one of ordinary skill in the art would have been motivated to combine the teachings of Asamaki et al. and Okumura

et al. for accurately measuring self-bias potential and that the incorporation of the auxiliary electrode of Okumura et al. into the plasma processing apparatus of Asamaki et al. would inherently produce an apparatus capable of producing the claimed plasma electron drift.

Okumura et al. merely teach a ring-form voltage monitoring conductor 11 that is configured to monitor the self-bias potential generated in the substrate 8. The Okumura et al. patent is directed to etching and cleaning methods in which an end of an etching process or cleaning process is determined based on the self-bias potential of the substrate, which is monitored by the voltage monitoring conductor (See Fig. 1 and Col. 2, lines 1-26). Conductor 11 is driven the same way as substrate electrode 7 so as to recreate the self-biasing potential on conductor 11 that exists on substrate 8. Since the self-biasing potential on substrate 8 cannot be measured directly, measuring the self-biasing potential on conductor 11 is used as a proxy for the self-biasing potential on substrate 8 (Col. 2, lines 47 and Fig. 2 and its related description). Thus, conductor 11 is driven to replicate the self-biasing potential on substrate 8 not to create a particular flow of electrons around the conductor fails to teach. Absolutely no suggestion or motivation exists in Okumura et al. that by applying an appropriate magnetic field, the electrons will drift as required by the claims. Okumura et al. do not teach or suggest producing a magnetic field capable of generating an ExB drift, wherein the electrons are caused to drift parallel to the front and back surfaces of the auxiliary electrode.

Although Asamaki et al. teach the generation of a magnetic field, they fail to teach an auxiliary electrode to produce electrons that drift as claimed. The cited patents teach bits and pieces of the claimed invention, but it would not be obvious to combine Asamaki et al. and Okumura et al. The claims of this application recite that the purpose of the invention is to produce electrons that drift across the front and back surfaces of the auxiliary electrode. This is accomplished by the claimed auxiliary electrode and the claimed magnetic field generator. Neither cited reference teaches a system that can produce the claimed electron drift. Asamaki et al. fail to teach or suggest that such a drift could be created by the addition of an auxiliary electrode. Okumura et al. fail to teach or suggest that the addition of a magnetic field generator could produce the claimed electron drift.

Therefore, no motivation exists from these references to combine their teachings as suggested in the Office Action. Therefore, the Office Action fails to present a *prima facie* case of obviousness.

Accordingly, reconsideration and withdrawal of rejection of claims 1-5 and 7 is respectfully requested.

Claim 6 was rejected under U.S.C §103(a) over Asamaki et al. in view of Okumura et al. and further in view of Shan, U.S. Patent No. 6,232,236. This rejection is traversed because Shan fails to provide any motivation to combine Asamaki et al. and Okumura et al. as discussed above with respect to independent claims 1 and 7.

Accordingly, withdrawal and reconsideration of the rejection of claim 6 is respectfully requested.

For at least the foregoing reasons, Applicants submit that the claims define patentable subject matter and that the entire application is in condition for allowance. Timely notice to that effect is therefore respectfully requested.

Should the Examiner believe that anything further is desirable to place the application in better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Attached is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **"Version with markings to show changes made"**.

All objections and rejections having been addressed, it is respectfully submitted that the present application is in a condition for allowance and a Notice to that effect is earnestly solicited.

Respectfully submitted,

Pillsbury Winthrop LLP

By: _____

Dale S. Lazar
Reg. No.: 28,872
Tel. No.: (703) 905-2126
Fax No.: (703) 905-2500

DSL/JMS/jc

P.O. Box 10500
McLean, VA 22102
(703) 905-2000

Enclosure: Appendix

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Page 1, line 5, the heading is changed as follows:

[TECHNICAL FIELD] FIELD OF THE INVENTION

Page 1, delete the whole paragraph starting in line 6, and replace it with the following new paragraph:

The present invention generally relates to a plasma processing apparatus and, more particularly, to a plasma processing apparatus which applies a magnetic field to a surface of a substrate to which a plasma process is applied. [and a] A plasma processing method can be performed [b] by such a plasma processing apparatus.

Page 1, delete the whole paragraph starting in line 6, and replace it with the following new paragraph:

Etching of a silicone oxidization film or a polycrystalline silicon film is [one of the most] an important process in the production of a semiconductor, and plasma etching has been used as such etching. In order to form a fine pattern of 1.0 μm or less by plasma etching, plasma having an ion current density of 1 mA/cm^2 or more and an electron density of 1×10 cm^{-3} or more is generally required under a process pressure of 0.5 Pa or less. However, a conventionally used RIE apparatus of a parallel plate type was not able to generate plasma of such conditions.

Page 2, delete the whole paragraph starting in line 6, and replace it with the following new paragraph:

[As] A solution which attains equalization of plasma density and a self-bias voltage, e.g., a method of giving a slope to a magnetic field (Japanese Laid-Open Patent Application No. 62-21062) or a method of rotating a magnetic field introduced into a process space (Japanese Laid-Open Patent Application No. 61-208223), [is] has been suggested. However, the solution suggested in Japanese Laid-Open Patent Application No. 62-21062 has a problem in that the optimum value of a slope magnetic field changes when a process pressure etc. is changed. Additionally, although the solution suggested in Japanese Laid-Open Patent Application No. 61-208223 apparently achieves equalization of plasma with respect to a substrate being processed, the mechanism for rotating the magnetic field is required, and there is a problem in that a miniaturization of the whole plasma apparatus is difficult.

Page 3, delete the whole paragraph starting in line 5, and replace it with the following new paragraph:

However, in association with increase of sizes of semiconductor chips such as DRAM or MPU, the diameter of the silicone substrate used as a base thereof has become [large] gradually larger. For example, in order to suppress a pressure distribution to less than several percent in the plasma apparatus which processes a substrate having a diameter of 300 mm or more, it is necessary to set a distance between the substrate and an upper electrode as 30 mm or more. In such a distance, diffusion of electrons which go from the surface of the substrate to the surface of the auxiliary electrode and from the auxiliary electrode to the surface of the substrate is suppressed. As a result, a movement of electrons is prevented and it is difficult to equalize the plasma.

Page 4, line 7, the heading is changed as follows:

[DISCLOSURE OF INVENTION] SUMMARY OF INVENTION

Page 4, delete the whole paragraph starting in line 25 and extending over to page 5, and replace it with the following new paragraph:

In order to achieve the above-mentioned objects, there is provided [a plasma processing apparatus] a plasma processing apparatus comprising a first electrode on which a substrate subjected to a plasma process is placed and a magnetic field [applying means] generator for applying a magnetic field to a surface of the substrate to which the plasma process is applied[, characterized in that: an]. An auxiliary electrode is provided on an outer periphery of the first electrode to excite plasma by the auxiliary electrode so as to cause electrons in the plasma to drift from a front surface to a back surface of the auxiliary electrode and from the back surface to the front surface of the auxiliary electrode.

Page 5, delete the whole paragraph starting in line 5, and replace it with the following new paragraph:

The front surface of the auxiliary electrode may be covered by an insulating material. Additionally, it is preferable that a level of a surface of the substrate placed on the first electrode and a level of the front surface of the auxiliary electrode [are] be substantially equal to each other or within ±2 mm. The magnetic field [applying means] generator may comprise a dipole ring-magnet. It is preferable that a first frequency [fl] of a radio frequency applied to the first electrode and a frequency [f2] of a radio frequency applied to the auxiliary electrode [are] be substantially equal to each other and phases thereof are different from each other.

Further, it is preferable that a frequency f2 of a radio frequency applied to the auxiliary electrode is higher than a frequency fl of a radio frequency applied to the first electrode (f2>fl).

Page 7, line 7, the heading is changed as follows:

[BEST MODE FOR CARRYING OUT THE INVENTION] DETAILED DESCRIPTION OF EMBODIMENTS

Page 7, delete the whole paragraph starting in line 11, and replace it with the following new paragraph:

FIG. 1 is a structural diagram of a plasma processing apparatus according to a first embodiment of the present invention. In the plasma processing apparatus shown in FIG. 1, a substrate 101 to which a plasma process is applied is placed on an electrode 102. A plasma process is applied to the substrate 101 by exciting plasma on the surface of the substrate 101. [The] A magnetic field generator, e.g. a dipole ring-magnet, 103 is provided in the circumference of a process chamber 108 in which the substrate 101 is accommodated [as a means] to apply a magnetic field. [As a means to apply a magnetic field, although] Although the magnetic field generated can be a permanent magnet or an electromagnet [may be used], it is preferable to use a dipole ring-magnet when installation capacity, electric power consumption, magnetic field leakage, etc. are taken into consideration.

Page 18, delete the whole paragraph starting in line 12, and replace it with the following new paragraph:

Additionally, using the plasma etching apparatus shown in FIG. 1, a silicon substrate was etched 300 times by introducing a mixed gas of C_4F_8, carbon monoxide, oxygen, and xenon into the process chamber and setting the pressure to 5 Pa. The silicone substrate had a silicone oxidization film with a thickness of 1.6 μm formed on the surface thereof and the diameter thereof was 200 mm. As a result measurement of the amount of consumption of eh auxiliary electrode 104, the amount of consumption was about 5 mm. Since the amount of consumption in a conventional etching apparatus is generally 65 mm, the amount of consumption was reduced to 1/13 of that of the conventional apparatus.

IN THE CLAIMS:

Please amend the following claims:

1. (Amended) A plasma processing apparatus comprising:

a first electrode; [(102) on which]

a substrate [(101; 807)] configured to be subjected to a plasma, the substrate being positioned on the first electrode; [process is placed and]

a magnetic field [applying means (103) for applying] generator configured to apply a magnetic field to a surface of the substrate [(101; 807)] to which the plasma process is applied; and [, characterized in that:]

an auxiliary electrode [(104) is] provided on an outer periphery of said first electrode [(102)] to excite plasma in a vicinity of [by] the auxiliary electrode, [(104) so as to cause]

wherein electrons in the plasma [to] drift from a front surface of said auxiliary electrode [(106)] to a back surface thereof [(105) of said auxiliary electrode (104)] and from the back surface of said auxiliary electrode [(105)] to the front surface thereof [(106) of said auxiliary electrode (104)].

2. (Amended) The plasma processing apparatus as claimed in claim 1, [characterized in that] wherein the front surface [(106)] of said auxiliary electrode [(104)] is covered by an insulating material [(902)].

3. (Amended) The plasma processing apparatus as claimed in claim 1 or 2, [characterized in that] wherein the substrate has a surface positioned at a level [of a surface of the substrate (101) placed on said first electrode (102) and] substantially equal to a level of the front surface of said auxiliary electrode [(104) are equal to each other or within ±2 mm].

4. (Amended) The plasma processing apparatus as claimed in claim 1 or 2, [characterized in that] wherein said magnetic field [applying means (103)] generator comprises a dipole ring-magnet.

5. (Amended) The plasma processing apparatus as claimed in claim 1 or 2, [characterized in that] wherein said first electrode is supplied with a first radio frequency [fl of a radio frequency applied to said first electrode (102)] and [a frequency f2 of a radio frequency applied to] said auxiliary electrode [(104)] is supplied with a second radio frequency and wherein the first and the second radio frequencies are equal to each other and have different phases thereof are different from each other.

6. (Amended) The plasma processing apparatus as claimed in claim 1 or 2, [characterized in that a] wherein said first electrode is supplied with a first radio frequency [f2 of a radio frequency applied to said auxiliary electrode (104) is higher than a] and said

auxiliary electrode is supplied with a second radio frequency [fl of a radio frequency applied to said first electrode (102) (f2>fl)] and wherein said second radio frequency is higher than said first radio frequency.

7. (Amended) A plasma processing method performed in a plasma processing apparatus comprising a first electrode [(102)] on which a substrate [(101) subjected to a plasma process is placed and magnetic field applying means (103) for applying a magnetic field to a surface of the substrate (101) to which the plasma process is applied, characterized by:] on which a substrate is positioned and an auxiliary electrode provided on an outer periphery of said first electrode, the method comprising:

subjecting the substrate to a plasma process containing a plasma;

applying a magnetic field to a surface of the substrate to which the plasma process is applied;

exciting plasma on at least a back surface [(105)] of [an] the auxiliary electrode [(104) provided on an outer periphery of said first electrode]; and

[cause] causing electrons in the plasma to drift from a front surface of said auxiliary electrode [(106)] to the back surface thereof [(105) of said auxiliary electrode (104)] and from the back surface of said auxiliary electrode [(105)] to the front surface thereof [(106) of said auxiliary electrode (104)].

End of Appendix